

## **DETERMINATION OF MATURITY STAGE FOR SOME PEACH CULTIVARS UNDER ISMAILIA CONDITIONS**

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### **ABSTRACT**

This research was carried out in 2006 & 2007, using three peach cultivars, i.e., Flordaprince, Desert Red and Meet Ghamr to determine fruit maturity. Fruit weight, skin and flesh colour (a) values were gradually increased during maturation. In Meet Ghamr skin (b) values were increased till the age of 121 days, then decreased at the age of 128 days and displayed the lowest (a/b) values. Flesh color of Desert Red was much more yellow color than that of Flordaprince, while Meet Ghamr displayed red color. Reductions in firmness and total acidity were showed with advanced stage of fruit maturity, while SSC and total sugars showed inversely trend.

### **INTRODUCTION**

Peach is one of the most popular fruit in the world because of its high nutrient level and pleasant flavour and its fruit is characterized by strong demand in different international markets (Wang *et al.*, 1998). In Egypt, according to the census of 2007, the area occupied with peach is about 83703 feddans. However, "Meet Ghamr" peach is a traditional specialty cultivar with a large demand to domestic market, while Flordaprince and Desert Red. are new cultivars imported by the Ministry of Agriculture and land Reclamation.

The concept of fruit maturity implies the utilization of a measurable character, changes in which can be used to indicate when a commodity should be harvested for a particular purpose. This character is known as a maturity or harvesting index (Reid, 1992). Maturity indices for various horticultural crops have relied on different features of the commodity, such as duration of development, size, density, starch or sugar content, color, firmness, which provide an adequate, estimate of maturity (Shewfelt, 1993). The decision of when to harvest peaches is a critical. Overripe fruit are extremely susceptible to mechanical damage and decay. Immature fruit may not ripen to standards required by consumers, and if stored under an inappropriate temperature regime, may develop undesirable attributes such as flesh "mealiness", browning, and other symptoms related to chilling injury. It is therefore critical to determine when a peach fruit has reached maturity and can reach the consumer in satisfactory condition, after having undergone a specified storage and handling period. Harvesting at the proper stage of maturity is essential for optimum fruit quality. Nectarines and peaches have to be harvested when mature, but not ripe, to permit long-distance transport with minimal injuries. Harvest maturity varies widely between species and cultivars. In peaches the periods of harvestable maturity is relatively short and must be determined for each cultivar and production region (Crisosto *et*

*al.*, 1998). The fruit weight, SSC and SSC/acid ratio increased gradually all over the fruit growth period until the maturity stage (Allam, 1988 ; Robertson *et al.*, 1992 and El-Etreby, 1996). On the other hand, firmness and acidity of peach fruits decrease with advanced stage of fruit maturity (Robertson *et al.*, 1992; Altube *et al.*, 1995 and Ravaglia *et al.*,1995). However, the green colour of twenty peach or nectarine cultivars replaced gradually by yellow and increased until the middle of the stage three, after which the skin turned red, then the intensity of the red skin coloration was increased until maturity (Kurnaze and Kazka 1993).

## **MATERIALS AND METHODS**

This search was carried out in two successive seasons (2006 & 2007) on the peach trees grown in sandy soil in a commercial orchard at Abou Swair area, Ismailia Governorate. The studied cultivars were Flordaprince, Desert Red and Meet Ghamr. All the cultivars were budded on Nemagard rootstock, 15-year-old, planted at 5x5 m apart and subjected to normal horticultural management of peach orchards. Thinning was practiced at the second week of February for Flordaprince, the third week of March for Desert Red and the third week of May for Meet Ghamr by leaving a single fruit at 10-15 cm distance on the carrying shoots depending on the number of leaves on them. The time of full bloom was recorded when 85% of the total produced flowers had opened and the number of days between full bloom and harvesting date was estimated for each cultivar.

At weekly intervals, 60 fruits were picked starting from the second week of April (from 77 to 90 days after full bloom) for Flordaprince, from the first week of May (from 86 to 101 days after full bloom ) for Desert Red and from the second week of June ( from 114 to 128 days after full bloom ) for Meet Ghamr, with a total of 3 harvest dates for each cultivar. The harvested fruits were transported to postharvest laboratory in Horticulture Department Faculty of Agriculture, Suez Canal University, within one hour of harvest. The fruits were divided into two equal groups. One group of 30 fruits was used for physical and chemical parameters at every harvest date. Another group of sound fruits were packed in perforated carton boxes in one layer and held in room temperature at 20±1°C and 50-60 %RH to study weight loss ,firmness, appearance ( immature or mature ) and shrinkage. Shrinkage degree of fruit flesh was classified using a subjective scale of 0-3 as follows : non = 0 ( sound fruit ) , light =1 ( less than 25% of fruit flesh was shrunk ) , moderate =2 ( between 25 and 50 % of the flesh was shrunk ) and severe=3 ( when more than 75% of the fruit flesh showed shrinkage ). Degree of shrinkage was calculated according to the following equation. Degree of shrinkage =  $\frac{\sum (\text{number of fruit in each category} \times \text{the scale number given})}{\text{number of fruit in sample}}$ . To determine if proper maturity is exactly attained at that specified date, the fruit flesh that did not shrink will be considered mature and their parameters will be measured. Measurements were performed at 4 or 5 days after harvest.

Fresh weight loss was expressed as a percentage of weight loss of each plate was calculated in relation to its initial weight as following equation:-

$$\text{Fresh weight loss \%} = \frac{\text{initial weight} - \text{sample weight}}{\text{initial weight}} \times 100$$

Fruit firmness (lb/in<sup>2</sup>) of each fruit was measured with an 8 mm dip penetrometer (Magness Taylor, Japan) on two opposite sides of the equatorial region of the fruit.

Soluble solids content (SSC %) was measured with a hand refractometer (Atago, Tokyo, Japan) in juice pressed from the whole fruit.

Titrate acidity % was determined by titrating 2 ml of juice with 0.1 N NaOH to pH 8 and calculating the result as malic acid equivalent.

Colour intensity Colour evaluation was done at two opposite sides of each fruit skin and flesh (after peeling fruits) using a Minolta CR 10 chromameter (Minolta corp, Japan) measuring "a" colour values, which indicate the relative green (-) or red (+) colour, and "b" colour values, which measure relative yellow (+) to blue (-) colour.

Total sugars were colorimetrically determined by phenol sulphoric acid method according to Stewart (1974).

Total phenolic compounds were quantitatively determined by Folin and Ciocaltu colorimetric method (A. O. A. C., 1985).

**Statistical analysis:** The data were analyzed to analysis of variance (ANOVA). A complete randomized design was used (Steel and Torrie, 1980). Analyses of variance and mean comparison (LSD at 5 %) were performed with Co-Stat program version 3.

## RESULTS AND DISCUSSION

### **Fruit maturation:**

**Fruit weight:** Data in Table 1 revealed that fruit weight of Flordaprince increased during maturation, where reached the maximum weight (99.5 and 95.5 g) at the age of 91 days, while fruit weight of Desert Red increased gradually till the age of 93 days, then this increment was sharply reached till maturity at the age of 100 days during the two seasons, respectively. However, fruit weight of Meet Ghamr increased gradually with the progress of maturation. Similarly, Allam (1988) stated that peach fruits increased in weight reached till maturity. Under Egyptian conditions, Flordaprince weighted 83 g (Mansour and Stino, 1987 and Shaltout, 1987), while Desert Red weighted 135-137 g (Shaltout, 1995).

**Fruit skin colour:** The changes in fruit skin colour are presented in Table1. The (a) colour values, which indicate the relative green (-) or red (+) colour of Flordaprince were -1.5 and -2.5 at the age of 77 days then increased during maturation to record 13.8 and 14.5 in the two seasons, respectively. This means that skin colour developed from green to red when the fruit reached 91 days. Concerning, Desert Red, (a) colour values increased with advanced maturity stage. It was (-3.1,-4.2) at the age of 86 days, however, it reached

(18.8, 20.5) at the age of 100 days in the first and second seasons, respectively. Generally, ground colour was gradually changed from green to red, and then the intensity of the red skin increased to reach the deepest rate at maturity (100 days) in both seasons. The (a) colour values of Meet Ghamr were slightly increased during maturity from (9.1,-11.4) at the age of 114 days from full bloom in both seasons, respectively. It is noticed that ground colour in this cultivar, changed from dark to light green and the greenish intensity in the skin was more than that of the other two cultivars. The (b) colour values, which measure relative yellow (+) to blue (-) colour, of Flordaprince and Desert Red were gradually increased with the advancement of maturation. This means that the external colour of Flordaprince and Desert Red was gradually changed from light yellow to yellow colour during maturity period. The (b) colour values of Meet Ghamr was increased from (33.3 and 30.2) at the age of 114 days to (35.2, and 32.2) at the age of 121 days, and then decreased sharply at the age of 128 days in the two seasons, respectively. A comprehensive CIE color evaluation of thirteen Peach cultivars conducted by Delwiche and Baumgardner (1983) revealed that differences in ground colour for different maturities occurred primarily in the "a" coordinate, which increased as maturation advanced. Slight increases in "b" coordinate of the ground color of "Baby Gold 6" fruit were observed by Amoros *et al.* (1989) during the first 70 days after fruit set. Afterwards, it was the "a" coordinate that increased drastically as the fruit developed red pigmentation in the skin.

The Hunter (a/b) values are presented in Table 1. The Hunter (a/b) values of Flordaprince were gradually increased with the progress of maturation period in the two seasons. This increase means that ground colour changed from green to red while the external color turned from green to yellow. It recorded (-0.06, and 0.08) at the age of 77 days, however, it reached to (0.47, and 0.43) after 91 days from full bloom in the first and second seasons, respectively. As for Desert Red, it could be seen that Hunter (a/b) values increased as fruit growth advanced towards maturity and attained a peak of 0.56-0.69 at 100 days from full bloom in the two seasons. Generally, ground color was gradually changed from green to yellow nevertheless, the deepest red color (external color) was observed at the age of 100 days. This cultivar displayed more red skin color (0.56 and 0.69) than Flordaprince (0.47, and 0.43) in both seasons, respectively. In Meet Ghamr, Hunter (a/b) values showed an increase from (-0.27, and 0.38) at the age of 114 days till (0.26, and 0.23) at the age of 128 days in the two seasons, respectively. This cultivar displayed lower (a/b) and less red in skin colour than the other two cultivars due to the ground color changed slowly from dark green to greenish-yellow.

**Fruit flesh colour:** The changes in flesh colour during maturation of the three studied cultivars during the two seasons are presented in Table 1. The (a) colour values in the pulp of the three studied cultivars was gradually increased with the progress of maturity, whereas the (a) colour values tended to indicate less red colour. Flesh (b) values of Flordaprince did not show sensible variations regardless of fruit age, yellow colour was very stable. A similar trend was observed in Desert Red but it displayed higher values when compared with the (b) values of Flordaprince. This indicate that flesh colour

of Desert Red was much more yellow colour than that of Flordaprince. Meet Ghamr displayed lower (b) values or pale yellow flesh colour compared with the flesh colour of Flordaprince or Desert Red in both seasons. However, in all studied cultivars, flesh (a/b) colour values were gradually increased with the progress of maturation period, nevertheless Desert Red gave the lowest (a/b) colour values which means that red colour disappeared in fruit flesh, the highest (a/b) colour values was obtained by Meet Ghamr which means that red colour displayed. Seymour *et al.*, (1993) reported that anthocyanines the primary red pigment in the vacuoles of peach cells may occur throughout the flesh in some cultivars with a concentration near the pit. Delwiche and Baumgardner (1985) studied peach skin colour using CIELAB notation and concluded that "a" is a useful fruit maturity index. Flesh or mesocarp "a" score has been reported to be a useful index for fruit maturity and processed fruit quality in clingstone peach (Fuleki and Cook, 1976 and Kader *et al.*, 1982). Robertson *et al.*, (1990) concluded that ground colour "a" scores are too variable to be useful as an universal maturity index in freestone peach. These results are in harmony with those of Kuranze and Kazka (1993) who found that the green ground and flesh colour of the twenties peach or nectarine cultivars were gradually replaced by yellow colour as the stage three began. The intensity of the red skin coloration increased until maturation but then decreased somewhat as the fruit ripened. The intensity of the yellow coloration increased until the middle of the stage three, after which the skin turned red. Ventura *et al.*, (1992); Ecchorzerbini, *et al.* (1994); Altube *et al.*, (1995) and Ravaglia *et al.*, (1995) reported that fruit colour is the most reliable maturity index.

**Fruit firmness:** As the fruit growth advanced towards maturity, there was gradual decrease in firmness of the three studied cultivars as shown in Table 1. The results showed that Meet Ghamr cv. had the lowest firmness at the end of maturation stage followed by Flordaprince and Desert Red, which had similar firmness values at the end of maturation period. The results showed that firmness measurement of the fruit could be used as index for fixing optimum stage of maturity for harvest. Softening of peaches has long been associated with the conversion of protopectin to soluble forms (Chapman and Harvat, 1990). Although changes in the other polysaccharides may be involved, the solubilization of pectin of this polysaccharide in the middle lamella. (Lester *et al.*, 1994). Altube *et al.*, (1995) and Ravaglia *et al.*, (1995) reported that firmness decreased significantly with advanced stages of fruit maturity. However, maturity of Flordaprince cv. occurred when firmness value reaches 16.5 lb/inch<sup>2</sup> (Mansour and Stino, 1987) or 15.5 lb/inch<sup>2</sup> (Shaltout, 1987), whereas it was 17.2 lb/inch<sup>2</sup> (Aly, 1988). Moreover, (Shaltout, 1995) found that fruit maturity occur in Desert Red and Swelling peach cultivars when firmness reached 11.8, 10.0 lb/inch<sup>2</sup>, respectively.

**Soluble solids content (SSC%):** SSC percentage of Juice in Flordaprince peach was gradually and significantly increased during maturation as shown in Table 2.



Similar trend was observed in Desert Red and Meet Ghamr cvs. However the highest SSC percentage was given by Meet Ghamr followed by Flordaprince and Desert Red in descending order. Robertson *et al.*, (1992) mentioned that SSC increased significantly with increased degree of maturation. Nevertheless, immature fruit have lower SSC than matured fruit (Mitchell, 1992). In relation work, the use of SSC% alone as maturity index is limited because of the variation among cultivars, trees, production areas and seasons (Crisosto, 1994). The maturity of Flordaprince cv. occurred when the SSC reached 12.5 % (Mansour and Stino, 1987 and Shaltout, 1987) or 12.95 % (Aly, 1988), while Desert Red was 9.5 % (Shaltout, 1995).

**Titrateable acidity:** It could be seen in Table 2 that total acidity was significantly decreased in all cultivars as the advancement of maturity increased. On the other hand, at maturity stage, Meet Ghamr had the lowest acidity (0.6 , 0.5 %) followed by Desert Red ( 0.9, and 0.95 %) and Flordaprince (1.0, and 1.1 %) in ascending order in both seasons. In studies carried out by Kader and Mitchell, 1989 and Deng *et al.*, (1998) on some peach cultivars, pointed out that maximum organic acids were in young fruits, then decreased gradually and reached their lowest values at maturity. Similarly, total acidity decreased gradually with advancing of peach fruit maturation as has been reported by Brooks *et al.*, (1993). Furthermore, maturity stage of Flordaprince occurred when acidity reached 0.9-1.0 % (Mansour and Stino, 1987 and Shaltout, 1987) or 1.1 % (Aly, 1988). However, in Desert Red, acidity value reached 0.93 % when maturity occurred (Shaltout, 1995).

**Total Sugars:** The data in Table 2 showed that total sugars in Flordaprince increased gradually and significantly till the age of 91 days in both seasons. While, in Desert Red total sugars increased till the age of 100 days in the first and second seasons. However, the difference between the first and second age (86-93 days) was not only significant in the first season. In Meet Ghamr, total sugars behaved in a similar manner as that of Flordaprince where it significantly increased significantly as the fruit age increased till maturity stage. The large increase in the concentration of sucrose that occurs during the latter stages of fruit development is accounted by an increase in activity of an important sucrose, synthesizing enzyme, sucrose synthase . Slight increases in glucose and fructose, on the other hand, are attributed to the greater activity of two enzymes involved in their metabolism, sorbitol oxidase and acid invertase (Moriguchi *et al.*, 1990).

**Total phenols:** In all peach cultivars, total phenols were significantly decreased with the advancement of maturity Table 2. However, in the two seasons, the differences were not significant between fruit age at 77 days and 84 days in Flordaprince cv., the corresponding age in Desert Red was 86 days and 93 days, and in Meet Ghamr was 114 days and 121 days. Although, the reductions in total phenols toward maturity, Meet Ghamr cv. fruits had the maximum values at age of 128 days (maturity) followed by Flordaprince and Desert Red fruits in descending order.





**Detection of maturity stage:** As mentioned before, peach fruit of various ages were packed and held at room temperature and examined daily. Table 3 showed the major changes that occurred during that period in fruit quality. Fruits that ripened normally without shrinkage and with low rate of weight loss were considered reached maturity. However, those unripe properly, shrunked, did not lose firmness, and lost high percentage of weight, were picked immature. Nevertheless, spoiled fruits were considered picked as ripe and neglected. So, Flordaprince reached maturity at the age of 91 days in both seasons. However, Desert Red reached this stage at the age of 100 days and Meet Ghamr at the age of 128 days in the two seasons. These results are in agreement with Mitchell (1992) who found that stone fruits that are harvested too soon may fail to ripen properly or may ripen abnormally. Immature fruits typically soften slowly and irregularly, never reaching the desired melting texture of fully matured fruit, and also susceptible to water loss than properly matured fruit. Overmature fruits have a shortened postharvest life, because they are already approaching a senescent stage at harvest. Moreover, Flordaprince maturity occurs after 79-85 days (Mansour and Stino, 1987, Shaltout , 1987 and Aly, 1988) or 90-100 days (Carous *et al.*, 1997), while Desert Red and Swelling reached maturity after (102-104) and (102-105) days from Full bloom, respectively (Shaltout,1995).

**Maturity indices:** From aforementioned results, maturity indices of the three studied peach cultivars are summarized in Table 4 as average of two seasons. The most reliable characters to determine maturity stage are fruit weight, fruit skin colour, fruit firmness, SSC and acidity. Those characters at maturity stage were as follows, fruit weight of Flordaprince was 100 g while, it reached to 110 g in Desert Red and 125.3 g in Meet Ghamr respectively. Hunter (a/b) colour values of fruit skin reached to 0.45 , 0.63 and 0.25 in Flordaprince , Desert Red and Meet Ghamr, respectively. However, fruit firmness recorded 13.2 lb/inch<sup>2</sup> in Flordaprince, 13.1 lb/inch<sup>2</sup> in Desert Red and 12.7 lb/inch<sup>2</sup> in Meet Ghamr. SSC in Flordaprince was 10.6%, the corresponding value in Desert Red was 10.6% and in Meet Ghamr was 12.1%. Total acidity reached to 1.0, 0.9 and 0.5 % in Flordaprince, Desert Red and Meet Ghamr, respectively. Thompson (1996) mentioned that characteristics such as fruit size, flesh firmness, ground colour of the skin, sugar content and titratable acidity are used as indices of maturity. However, Crisosto (1994) indicated that the assessment of maturity from the combination of change in ground colour and flesh firmness was a practical technique for the harvest of peach fruit with high eating quality and long storage life. An ideal maturity index should meet the following criteria; simple to measure, objective, applicable to all growing sites and years, and preferably, nondestructive Reid (1992).

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### تحديد ميعاد اكتمال النمو لثمار بعض أصناف الخوخ تحت ظروف محافظة الإسماعيلية

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أجريت هذه الدراسة خلال موسمي ٢٠٠٦ – ٢٠٠٧م على ثلاث أصناف خوخ هي فلوردا برنس وذررت رد و ميت غمر بهدف تحديد ميعاد اكتمال النمو لثمار كل صنف. أظهرت النتائج زيادة تدريجية في كل من وزن الثمرة و قيم اللون (a) الخاصة بجلد و لحم الثمار مع تقدم نمو الثمرة نحو اكتمال النمو. أما بالنسبة لثمار الصنف ميت غمر فقد زاد قيمة اللون (b) الخاصة بالجلد حتى عمر ١٢١ يوم ثم حدث انخفاض حتى عمر ١٢٨ يوم من التزهير الكامل في حين أعطى أقل قيم للون (a/b). و كان لحم ثمار الصنف ذررت رد أكثر اصفرار عن الصنف فلوريدا برنس أما ثمار الصنف ميت غمر فأظهر لحم ذات لون أحمر. لوحظ انخفاض في كل من الصلابة و الحموضة الكلية في ثمار جميع الأصناف مع اقتراب الثمار لمرحلة اكتمال النمو وعلى العكس من ذلك فقد لوحظ اتجاه معاكس لكل من محتوى المواد الصلبة الذائبة و نسبة المواد الصلبة الذائبة إلى الحموضة و أيضاً السكريات الكلية.

### قام بتحكيم البحث

كلية الزراعة – جامعة المنصورة  
مركز البحوث الزراعية

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**Table (3): Detection of maturity stage for some peach fruit cultivars in 2006 & 2007 seasons**

Cultivars	Fruit age (days)	Inspection intervals (days)	2006 season				Inspection intervals (days)	2007 season			
			Weight Loss (%)	Shrinkage degree**	Firmness (lb/in <sup>2</sup> )***	Appearance		Weight Loss (%)	Shrinkage degree**	Firmness (lb/in <sup>2</sup> )***	Appearance
Flordaprince	77	5	22.6	2	14.6	immature	5	19.8	3	14.0	immature
	84	5	18.5	2	11.5	immature	4	20.4	3	12.5	immature
	91	4	8.3	0	3.8	mature	4	8.5	0	4.1	mature
Desert Red	86	5	20.6	2	13.5	immature	5	22.5	3	13.2	immature
	93	5	19.2	2	10.2	immature	5	18.7	2	10.5	immature
	100	5	8.6	0	4.1	mature	5	7.7	0	3.2	mature
Meet Ghamr	114	5	14.8	3	12.4	immature	5	18.4	3	13.1	immature
	121	4	11.6	1	9.4	immature	5	14.6	2	9.5	immature
	128	4	8.4	0	3.5	mature	4	8.2	0	3.8	mature

\*Number of days from full bloom. \*\* 0 = Non, 1 = Light 25%, 2 = Moderate 25-50% and 3 = severe, more than 75% \*\*\* After storage at 20°C

**Table (4): Maturity indices of some peach fruit cultivars ( average of two seasons 2006 & 2007)**

Cultivars	Days from full bloom	Fruit weight (g)	Skin colour a/b*	Flesh colour a/b*	Firmness (lb/in <sup>2</sup> )	SSC (%)	Acidity (%)	Total sugars (mg/100ml)	Total phenols (mg/100ml)
Flordaprince	91	100	0.45	0.21	13.2	10.6	1.0	6.5	66.5
Desert Red	100	110	0.63	0.12	13.1	10.6	0.9	5.9	63.5
Meet Ghamr	128	125.3	0.25	0.29	12.7	12.1	0.5	6.6	83.4

\*a = ( green – red )

b = ( yellow – blue )